BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

CLAIMS

1. A cryoablation system comprising a coolant console having

a reservoir of phase change coolant

first means for providing the phase change coolant from the reservoir at elevated pressure along an inlet line to a cryotreatment probe

second means for recovering the phase change coolant from the cryotreatment probe and raising its pressure

said first and second means forming a supply loop through the cryotreatment probe and the first means being arranged in heat exchange communication to condition the coolant before it reaches the probe along the inlet line so as to achieve effective cooling regimens by controlling phase change coolant provided along the inlet line while continuously recovering and recirculating expended coolant.

2. The cryoablation system of claim 1, wherein the first means conditions temperature of the coolant at elevated pressure in the inlet line, and further comprising

a pressure regulator for controlling flow of coolant between the inlet line and the probe, and

a processor configured for setting the pressure regulator to effect a treatment cycle.

3. The cryoablation system of claim 1, wherein said second means includes a vacuum communicating return passage forming a vacuum jacket about the inlet line for thermally insulating the circulating coolant.

4. The cryoablation system of claim 2, wherein the processor sets treatment cycles of a first duration for mapping and treatment cycles of a second duration for ablation.

5. The cryoablation system of claim 2, wherein the processor sets treatment cycles of a first pressure for treatment of point regions and treatment cycles of a second pressure for treatment of linear regions.

6. The cryoablation system of claim 2, wherein the processor sets treatment cycles of a first pressure for mapping and treatment cycles of a second pressure for ablation.

7. The cryoablation system of claim 1, further comprising

a return line configured for returning unconditioned coolant under pressure from the supply loop to the reservoir.

8. The cryoablation system of claim 1, wherein the second means includes a vacuum pump for drawing expended coolant from the cryotreatment probe, and said vacuum pump raises pressure of said expended coolant for return to the first means.

9. The cryoablation system of claim 8, wherein the reservoir provides said phase change coolant at a first pressure to said first means, and the vacuum pump returns the expended coolant to the first means along a return line at a pressure above said first pressure.

10. The cryoablation system of claim 1, wherein the system includes a compressor.

11. A coolant system for providing cryoablation fluid to a cryotreatment probe such as a mapping or ablation catheter, wherein the coolant system comprises

a tank for holding a coolant liquid, said tank having an inlet and an outlet

a pressure regulator for reducing pressure of liquid from the outlet for facilitating phase change of said liquid

a heat exchanger for placing a catheter coolant injection line in heat exchange relation with said reduced pressure liquid to thereby cool the coolant injection line

a compressor, and a condenser, the reduced pressure liquid passing through the condenser and into the compressor to form a hot pressurized vapor output

the hot pressurized vapor output passing through the condenser along said injection line to become a cooled pressurized output while vaporizing the reduced pressure liquid prior to its entry into the compressor, and

pressure regulation means downstream of the condenser,

said pressure regulation means

building up pressure of said cooled pressurized output in a first branch for returning coolant to the tank inlet, and

conditioning and controlling the coolant in a second branch for injection into the cryotreatment probe.

12. The coolant system of claim 11, further comprising

a vacuum recovery unit connectable to the probe for receiving return flow of injected coolant therefrom

said vacuum recovery unit including a vacuum pump which receives said return flow at a vacuum inlet side thereof and pumps it to a pump outlet side, and

a recovery return line extending from said pump outlet side to the reduced pressure liquid downstream from the tank outlet thereby forming together with the catheter a supply loop for said cryoablation fluid.

13. The coolant system of claim 12, further comprising a bypass return line connected between said probe inlet side and said recovery return line, said bypass return line including a pressure regulator for reducing pressure from said probe inlet side to a lower pressure of said recovery return line, and wherein said lower pressure of the recovery return line is higher than pressure of the reduced pressure liquid from the refrigerant tank, thereby assuring circulation of cryoablation fluid in the supply loop through the probe, the compressor and the condenser.

14. A coolant system for operation of a cryotreatment catheter to treat a patient, such system comprising

a reservoir of phase change fluid

a compressor for elevating the pressure of said fluid

a conditioning assembly for conditioning temperature of the elevated pressure fluid

a microprocessor-controlled pressure regulator for setting a cryotreatment supply regimen of defined pressure and duration to supply an effective amount of conditioned fluid to a coolant port of the cryotreatment probe, and

a vacuum recovery assembly connectable to the cryotreatment probe for continuously drawing expended fluid from the probe thereby preventing leakage into the bloodstream of the patient.

15. The coolant system of claim 14, wherein the vacuum recovery assembly returns the expended fluid at intermediate pressure to the compressor thereby forming a closed supply loop of said conditioned temperature elevated pressure fluid supplied to the pressure regulator.

16. The cryoablation system of claim 14 further including protection valves coupled to the compressor for allowing the fluid to return directly to the compressor.